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SPECIFICATION FOR FLAMEPROOF ALTERNATING CURRENT MOTORS FOR USE IN MINES

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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SPECIFICATION FOR FLAMEPROOF ALTERNATING CURRENT MOTORS FOR USE IN MINES

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Indian Standard

SPECIFICATION FOR FLAMEPROOF ALTERNATING CURRENT MOTORS FOR USE IN MINES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 3 August 1966, after the draft finalized by the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 In mines generally humid, dust-laden, restricted ventilation conditions can be expected, and electrical equipments for use in such locations require special considerations as to their design, rating and performance. This standard is intended to cover flameproof ac motors for use in mines.

0.3 The requirements for flameproof enclosures of electrical machinery and apparatus for use in mines and such other places where flammable gases or vapours may exist or may originate inside the enclosure are covered by IS : 2148-1962[*]. The tests and performance requirements of motors are covered by IS : 325-1961[†] and IS : 996-1964[‡]. These standards therefore form necessary adjuncts to this standard.

0.4 In preparing this standard assistance has been derived from B.S. 741 : 1959 'Flameproof electric motors for conveyors, coalcutters, loaders and similar purposes for use in mines' issued by the British Standards Institution.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960[§]. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers flameproof ac motors designed for use in mines and having insulated windings with class A, E and B insulation (*see* IS : 1271-1958[||] and IS : 996-1964[‡])

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[*] Specification for flameproof enclosures of electrical apparatus. (Since revised).

[†] Specification for three-phase induction motors (*second revision*). (Since revised).

[‡] Specification for single-phase small ac and universal electric motors (*revised*).

[§] Rules for rounding off numerical values (*revised*).

[||] Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 325-1961* and IS : 2148-1962† shall apply.

3. FLAMEPROOF ENCLOSURES

3.1 Flameproof Enclosures — The enclosures of motors complying with this standard, shall be constructed in accordance with IS : 2148-1962†.

3.1.1 For the purpose of this specification, which is to meet the ordinary requirements of the coal mining industry, the prescribed flammable gas in the surrounding atmosphere is methane (Group 1).

NOTE — As the condition of flameproof enclosure is limited to operation within the rating of the apparatus, means should be provided to ensure, as far as is practicable, that this rating will not be exceeded. The consequence of a destructive short-circuit within the apparatus must be guarded against by means to ensure the automatic interruption of the short-circuit elsewhere before the risk of destruction of the enclosure supervenes.

3.1.2 *Types of Flameproof Enclosures* — The following types of flameproof enclosures are permissible:

a) A totally-enclosed motor (TE) is a motor so constructed that the enclosed air has no connection with the external air, but not necessarily ' air-tight ';

b) A totally-enclosed fan-cooled moter (TEFC) is a totally-enclosed motor with augmented cooling by means of a fan driven by the motor itself, blowing external air over the cooling surfaces and/or through the cooling passages, if any, incorporated in the motor;

c) A totally-enclosed separately air-cooled motor (TESAC) is a totally enclosed motor with augmented cooling by means of a separately-driven fan blowing external air over the cooling surfaces and/or through the cooling passages, if any, incorporated in the motor; and

d) A totally-enclosed water or other liquid-cooled motor (TEWC) is a totally-enclosed motor with augmented cooling by means of water or other liquid-cooled surfaces embodied in the motor itself.

4. GENERAL CONSTRUCTION

4.1 The enclosure of every motor shall constitute a flameproof enclosure, either self-contained, or when assembled to its adjacent component apparatus.

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*Specification for three-phase induction motors (*second revision*). (Since revised).

†Specification for flameproof enclosures of electrical apparatus. (Since revised).

4.1.1 In the case of slip-ring motors the windings and slip-rings may be housed in the main flameproof enclosure or in separate flameproof enclosures.

4.2 Earthing Arrangement — Two separate earthing terminals shall be provided. One of these shall be located inside the terminal box.

4.3 Terminal Markings — Terminal markings, when used, shall be in accordance with Appendix B of IS : 325-1961*

5. RATING PLATE AND DIAGRAM OF CONNECTIONS

5.1 A rating plate stating the following shall be supplied with each motor:

a) Flameproof ac motor;
b) A reference to the designation of this standard, that is, Ref ISS 3682;
c) Name of manufacturer;
d) Manufacturer's number and frame reference;
e) Class of rating or the necessary information if the motor is intended to operate under more than one class of ratings;
f) Frequency in cycles per second;
g) Number of phases and the phase connections;
h) Rated output in kW;
j) Rated voltage;
k) Approximate current in amperes at rated output;
m) Approximate speed in revolutions per minute at rated output;
n) The rotor voltage on open circuit between slip-rings (for slip-ring motors only);
p) Rotor current in amperes at rated output (for slip-ring motors only); and
q) The class of insulation.

5.1.1 Flameproof induction motors shall have the registered flameproof mark.

Note — For particulars of the registered flameproof mark, reference is invited to IS : 2148-1962†.

5.2 A diagram of connections including instructions for changing the direction of rotation shall be affixed to the inside of the terminal cover.

6. RATED VOLTAGE AND FREQUENCY

6.1 Rated Voltages — The preferred rated voltages shall be 115, 415, 525 and 3 300 V.

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*Specification for three-phase induction motors (*second revision*). (Since revised).

†Specification for flameproof enclosures of electrical apparatus. (Since revised).

6.2 Rated Frequency — The rated frequency shall be standard frequency of 50 cycles per second.

7. RATED OUTPUTS

7.1 The preferred rated outputs for flameproof induction motors up to and including 110 kW shall be as specified below:

kW
0·75
1·1
1·5
2·2
3·7
5·5
7·5

kW
9·3
11
15
18·5
22
30
37

kW
45
55
75
90
110

7.1.1 Above 110 kW, the preferred outputs shall follow the R20 series as specified in IS : 1076-1957*.

7.1.2 Motors up to and including 22 kW shall be designed for direct-on-line starting, motors of output more than 22 kW shall also preferably be designed for direct-on-line starting.

7.1.3 Motors of 90 kW and above should preferably be designed for use on 3·3 kV system.

8. RATING

8.1 For the purpose of this standard, the following classes of ratings are recognized in accordance with **2.1.1** and **2.1.2** of IS : 325-1961†.

8.1.1 *Continuous Rating* (*CR*) — Unless otherwise specified, motors complying with this specification shall be continuously rated.

8.1.2 *Short Time Rating* — The standard short time rating shall be as follows:

a) One half-hour rating. The output at which a motor can work for half an hour and comply with this standard.

b) One-hour rating. The output at which a motor can work for one hour and comply with this standard.

c) Two-hour rating. The output at which a motor can work for two hours and comply with this standard.

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*Preferred numbers. (Since revised).

†Specification for three-phase induction motors (*second revision*). (Since revised).

8.2 Rating for Multispeed Motor — A multispeed motor shall have a definite rating for each speed.

8.3 Rating for Other Duty Cycles — It may not be possible to apply any of the above classes of ratings (*see* **8.1**) to a particular motor subjected to an intermittent or duty cycles service. In such a case, the purchaser shall provide the manufacturer with details of the required duty cycle, so that, by agreement, an appropriate rating of the motor may be established. Tests to be carried out at the manufacturer's works shall also be agreed upon.

9. PERFORMANCE

9.1 The performance requirements of motors shall be in accordance with **10** and **11** of IS : 325-1961* and IS : 996-1964†, respectively.

10. TEMPERATURE-RISE

10.1 The temperature-rise of motors, when tested under the rated conditions and in accordance with the requirements of this standard, shall not exceed the values appropriate to the class of insulation stated in Table 1 to be read in conjunction with the following and **10.1.1** and **10.1.2**:

a) Where a voltage range is not specified, motors shall be capable of operation without injurious heating over a range of voltages not exceeding plus and minus 6 percent of the rated voltage, and
b) The method of temperature measurement to be employed for each part of the motor shall be as stated in Table 1 subject to the following:
    1) If the windings of a motor stated in Item (i) of Table 1 are not readily accessible to thermometers, the resistance method may be used by agreement between the manufacturer and the purchaser, with temperature limits specified in Table 1.
    2) If thermometers are used as a check on the specified resistance methods, the temperature-rises so measured shall be subject to the limits given in Table 1 for the specified methods.
    3) Where the windings and the slip-rings to which they are connected, are insulated with different classes of insulating material, the temperature-rise associated with the lower class shall apply to the slip-rings.

10.1.1 The limits of temperature-rise of motors dependent on air cooling, as measured above the temperature of the cooling air (*see* Appendix D of IS : 325-1961*) shall not exceed values stated in Table 1 subject to the following:

a) The limits of temperature-rise specified in Table 1 are applicable to motors intended to operate with a cooling air temperature not

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*Specification for three-phase induction motors (*second revision*). (Since revised).

†Specification for single-phase small ac and universal electric motors (*revised*).

exceeding 40°C. No alteration in these limits shall be made if the specified air cooling temperature is lower than 40°C.

b) Temperature tests may be carried out at any convenient air temperature but unless otherwise agreed not lower than 10°C. If the cooling air temperature during the test differs from that specified, no correction shall be made on account of such difference.

c) When a motor is specified to operate at site with the cooling air temperature higher than 40°C the permissible temperature-rise given in Table 1 to be reduced by:
   1) 5 deg C if the cooling air temperature is between 40 and 45°C,
   2) 10 deg C if the cooling air temperature is between 45 and 50°C, and
   3) As agreed between purchaser and manufacturer if it is more than 50°C.

TABLE 1 LIMITS OF PERMISSIBLE TEMPERATURE-RISE FOR ac MOTORS OF CONTINUOUS MAXIMUM RATING OR SHORT-TIME RATING

(*Clause* 10.1)

SL No.	PART OF MOTOR	METHOD OF MEASUREMENT	TEMPERATURE-RISE FOR CLASS OF INSULATION		
			A	E	B
(1)	(2)	(3)	(4)	(5)	(6)
			deg C	deg C	deg C
i)	Insulated windings	Thermometer	50	65	70
		Resistance	60	75	80
ii)	Slip-rings	Thermometer	60	70	70
iii)	Iron cores and other parts in contact with insulated windings	Thermometer	55	65	75
iv)	Permanently short-circuited windings un-insulated	—	The temperature-rise shall, in no case, reach such a value that there is a risk of injury to any insulating material on adjacent parts		
v)	Iron cores and other parts not in contact with insulated windings				
vi)	External surface	Thermometer	50	60	60

10.1.2 The limits of temperature-rise of motors dependent on water cooling as measured above the cooling water inlet temperature shall be 10 deg C higher than the values stated in Table 1 except external surface temperature, subject to the following:

a) The limits of temperature-rise specified are applicable to motors specified to operate with a cooling water inlet temperature not exceeding 30°C. If the specified cooling water temperature is lower than 30°C the limits of temperature-rise specified shall be applicable unless otherwise agreed to between the purchaser and the manufacturer. In such circumstances the increase in permissible temperature-rise shall not be greater than the amount by which the specified inlet water temperature is below 30°C.

b) Temperature tests may be carried out at any covenient cooling water temperature. If the cooling water temperature during the test differs from that specified no correction shall be made on account of such difference.

c) When the specified cooling water temperature exceeds 30°C the limits of temperature rise shall be reduced below those permitted by the amount of such excess.

11. TOLERANCES

11.1 When tenders include guarantees, the tolerances shall be in accordance with Table 2 of IS : 325-1961* or Table 4 of IS : 996-1964† as applicable.

12. TESTS

12.1 Tests for Flameproofness — Tests to prove that the enclosure of the motor is flameproof shall be carried out by the recognized testing authority and any apparatus purporting to comply with the specification shall be so tested, unless the recognized testing authority has issued a certificate of such compliance without submission to test upon grounds which, in the testing authority's discretion, are deemed to be adequate.

12.2 All the other type tests and routine tests shall be carried out according to **14.3** and **14.4** of IS : 325-1961* or **15.3** and **15.4** of IS : 996-1964† as applicable.

13. GENERAL INFORMATION TO BE GIVEN WITH ENQUIRY AND ORDER

13.1 The particulars listed in Appendix A shall be provided by the purchaser if required by the supplier.

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*Specification for three-phase induction motors (*second revision*). (Since revised).

†Specification for single-phase small ac and universal electric motors (*revised*).

APPENDIX A

(*Clause* 13.1)

INFORMATION TO BE GIVEN WITH ENQUIRY AND ORDER

1. Rated output in kilowatts.

2. a) Approximate speed in RPM at rated output.
   b) Voltage, number of phases and frequency.
   c) If the motor is to operate between various limits of voltage, frequency and speed, their values.

3. a) Class of insulation, namely, Class 'A', 'E' or Class 'B'.
   b) Class of rating (*see* **8**).
   c) Type of duty, values and duration of over-loads.

4. Type of enclosure in detail (*see* **3**).

5. The maximum cooling air temperature in which the motor is intended to work.

6. Maximum permissible temperature-rise of motor required, if different from limits specified in this standard.

7. Altitude of operating site, if it exceeds 1 000 metres (in site and operating conditions).

8. The nature of the atmosphere (dust, moisture, corrosive vapours or gases), if necessary

9. Types of rotor (squirrel-cage or slip-ring).

10. If wound type of rotor, the type of slip-ring gear, whether continuously rated or for starting purposes only and whether to be fitted with brush-lifting and/or short-circuiting arrangements.

11. a) Mounting details, such as horizontal, vertical (whether with shaft extension pointing upwards or downwards) or flange mounting.
    b) Details of drive, such as direct coupling, belt drive, gear drive, etc.
    c) In the case of motors with vertical shaft or with horizontal shaft having a common bearing with driven machine, the additional weight and thrust on the suspension bearing or on the common bearing.

12. Methods of starting to be employed (such as direct on line, star, delta, auto-transformer or rotor resistance).

13. a) Starting torque as percentage of rated full load torque and the corresponding starting current which can be taken from the line with the starting accessories connected.
    b) Any information regarding the driven machine which has a bearing upon the torque required during the starting period and the kinetic energy of the moving parts to be accelerated.

14. Details of shaft extension(s) required.

15. Particulars of tests required and where they are to be carried out.

16. a) Particulars of cable connection required.
    b) Direction of cable entry.

17 In the case of HV motors, the fault level of the electric power supply system to which the motor is connected.

18. In the case of HV motors type of bearings, i.e., whether roller, sleeve, etc.

(*Continued from page* 2)

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